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A COMPARISON OF LIGHTNING AND AIRCRAFT SOURCES OF NOX IN THE UPPER TROPOSPHERE

Joyce E. Penner, Dan Bergmann, Colin Price, Michael J.Prather, Britton Chang,
Steven L. Baughcum, Ken Pickering, Douglas Rotman, John J. Walton

Previously, we derived a global rate for cloud-to-ground (CG) flashes of 20-30 flashes/sec with a mean energy per flash of 6.7x109 J. Intracloud (IC) flashes are more frequent, 40-70 flashes/sec, but have 10% of the energy of CG strokes and consequently produce significantly less NOx. Using a method to simulate global lightning frequencies from satellite-observed cloud data, we have calculated the LNOx on various spatial and temporal scales. Regionally, the production of LNOx is concentrated over tropical continental regions, while mainly in the summer hemisphere. On an annual basis 64% of the LNOx is produced in the northern hemisphere, implying that the northern hemisphere should have natural ozone levels as much as two times greater than the southern hemisphere, even before anthropogenic influences. Although most of LNOx is produced in the lowest 5 km by CG lightning, convective mixing in the thunderstorms is likely to deposit large amounts of NOx in the upper troposphere where it is important in ozone production. In this paper we compare the distribution of NOx produced by lightning to that derived from aircraft sources. The distributions predicted by three different chemical transport models are compared.

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